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PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Process for Improving the Mechanical Properties of Copper Alloys containing from 0.2 to 3% of Chromium.

We, METALLGESELLSCHAFT AKTIENGESELLSCHAFT, of 45, Bockenheimer Anlage, Frankfurt-on-the-Main, Germany, a Corporation organised under the Laws of Germany, Professor Dr. WALTER FRAENKEL, of 50, Freiherr von Steinstrasse, Frankfurt-on-the-Main, Germany, and Dr. ARTHUR BURKHARDT, of 4, Schneidhainerstrasse, Frankfurt-on-the-Main, Germany, both German Citizens, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a process for improving the mechanical properties of copper alloys containing from 0.2 to 3% of chromium.

Alloys of copper with small amounts of chromium have long been known, and are largely employed in industry on account of their good mechanical and chemical properties.

It has now been ascertained, in accordance with the present invention, that the mechanical properties of such copper alloys containing from 0.2 to 3% of chromium, can be improved by a two-stage heat treatment which comprises heating said alloys at temperatures lying between 700° C. and their melting point, and thereupon quenching and finally ageing at temperatures lying between 350° C. and 700° C. If, for example, a copper alloy containing 1% of chromium be heated to 1000° C. and quenched, it exhibits a hardness of 50 kg. per sq. mm., which is increased to about 75 kg. per sq. mm. by heating for an hour at 500° C. Apart from binary chromium-copper alloys it has unexpectedly been found that ternary copper alloys, containing 0.2 to 3% of chromium and 1 to 10% of aluminium, can also be improved by heating, quenching and ageing. Thus, for example, an alloy of copper with 3% of aluminium and 1% of chromium has a hardness of about 50 kg. per sq. mm. after quenching from 950° C., the hardness increasing to about 100 kg. per sq. mm. after heating at 500° C. for 2 hours.

The quenching may also consist of cooling in air following hot working at temperatures above 700° C. The subsequent ageing is effected by tempering at temperatures between 350° and 700° C.

Additions of one or more further elements other than beryllium, titanium or silicon, for instance such elements as are taken up as solid solutions, by copper and as do not enter into combination with chromium and derange the improving treatment per se, may be made to the binary and ternary alloys hereinbefore set forth for the purpose of further improving the mechanical properties. Chief among these are additions of nickel in proportions of 1 to 5% tin in quantities of 1 to 10% and zinc up to about 20%. These additions are, of course, restricted to such elements as do not enter into separate combination with the chromium. It is known that the addition of silicon results in the formation of a chromium silicide, and that copper alloys containing chromium silicide are normalisable. The present invention, however, is based on the unexpected discovery that chromium by itself and without the presence of an element combining therewith, renders copper alloys capable of being improved. Finally, it was also known that copper-chromium alloys can be softened for subsequent working, by being quenched from 900—975° C. Nevertheless, a process of this kind has nothing in common with an improving treatment consisting of heating, quenching and subsequent ageing at an elevated temperature. Consequently, the essential feature resides in this two-stage heat treatment, which enables the malleability to be maintained whilst at the same time the properties in respect of strength are improved.

The alloys treated in accordance with the present invention are particularly valuable for the manufacture of fireboxes or parts of same. Such fireboxes have in part to absorb high stresses, because expansion occurs on heating, whilst on the other hand, such expansion is opposed by the staybolts. In order to prevent leakage it is therefore necessary to employ heat-resisting alloys, such as are

represented by those composed and treated in accordance with the present invention.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1). A process for improving the mechanical properties of alloys consisting of copper with 0.2 to 3% of chromium, which comprises heating the alloys at temperatures lying between 700° C. and the melting point of said alloys, and then quenching and ageing them at temperatures between 350° and 700° C.

2). A process for improving the mechanical properties of alloys consisting of copper with 0.2 to 3% of chromium, which comprises subjecting the alloys to working at temperatures exceeding 700° C. and after cooling them in the air, heating then to temperatures between 350° and 700° C.

3). The application of the process set forth in claim 1 or 2, to alloys composed of copper and 0.2 to 3% of chromium and 1 to 10% aluminium.

4). The application of the process set forth in claim 1 or 2, to alloys composed of copper, 0.2 to 3% of chromium and additions, other than beryllium, titanium or silicon, of one or more elements which do not enter into combination with chromium.

5). The application of the process set forth in claim 1 or 2, to the alloys set forth in claim 4, containing additions of one or more of the elements nickel in amounts of 1 to 10%, tin 1 to 10% and zinc 1 to 20%.

6). The application of the process set forth in claim 1 or 2, to the alloys set forth in claim 5, containing an addition of 1 to 10% of aluminium.

7). The process for improving the mechanical properties of copper alloys containing 0.2 to 3% of chromium, substantially as described.

8). Alloys, consisting of copper with 0.2—3% of chromium whenever improved in respect of mechanical properties by the process claimed in any of claims 1, 2 and 7.

9). An alloy as set forth in claim 8, containing in addition a further element, such as zinc, tin, aluminium or nickel, but not beryllium, titanium or silicon.

10). The application of the alloys set forth in claims 8 and 9, to the manufacture of fireboxes or parts thereof.

Dated this 12th day of January, 1933.

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